REMARKS

Claims 1-30, 35-37, and 39-41 are pending in the application. A terminal disclaimer is enclosed to overcome the double-patenting rejections at pp. 3-4 of the Office Action. Claim 25 has been amended to expressly describe a heating step. Reconsideration and withdrawal of the remaining rejections are requested in view of the following remarks.

The claims are directed to methods for cleaning a flat media workpiece, wherein a liquid jet (or jet of steam) is directed through a heated liquid boundary layer on the surface of the workpiece to physically dislodge contaminants from the workpiece. The boundary layer liquid, and the liquid of the jet, may be the same liquid, or different liquids. Ozone is provided into the environment around the workpiece. The ozone diffuses through the boundary layer to react at the workpiece surface. The chemical reaction between the ozone and organic contaminants removes the contaminants. Thus, the claimed methods provide an improved process for cleaning a workpiece, involving both reaction of ozone at the workpiece surface, and physical removal of contaminants from the workpiece via a liquid jet directed through a heated liquid boundary layer.

Turning to the § 103 rejections at pp. 2-3 of the Office Action, none of the cited references teach directing a liquid jet (or jet of steam) through a heated liquid boundary layer on a workpiece to physically dislodge/remove a contaminant from the workpiece, as recited in independent claims 1, 25, and 35. In response to page 4 of the Office Action, and the interpretation of "spray" vs. "jet," the application at paragraphs [0107] and [0108] expressly defines what a "jet" of liquid is, and clearly distinguishes the term

"jet" from the term "spray." The application defines "jet" as "a substantially solid or continuous column of liquid impacting the workpiece." A concentrated jet or beam of liquid impacts on a small spot on the workpiece" (paragraph [0108]).

The application further states that "the liquid 58 formed into the high pressure jet 62 penetrates through the boundary layer 73 of liquid on the workpiece surface and impinges on the workpiece surface with much more kinetic energy than in conventional water spray processes" (paragraph [107]). Thus, the term "liquid jet," as used in the claims, is clearly distinguished in the application from the term "spray." Accordingly, references teaching methods of treating workpieces with a liquid spray do not teach or suggest the claimed methods of directing a liquid jet (or jet of steam) through a heated liquid boundary layer to physically remove contaminants from a workpiece.

Turning to the prior art, Matsuoka is the only reference cited as teaching that a liquid is "jetted" onto a workpiece surface. Matsuoka, however, does not teach or suggest the step of directing a liquid jet (or jet of steam) through a liquid boundary layer to physically dislodge/remove a contaminant from a workpiece, as claimed. Rather, Matsuoka teaches that ultra-pure water is "jetted" through a nozzle while a rotary table is rotating so that thin films of ultra-pure water are formed on the surfaces of the substrates (p. 5, lines 26-28). Thus, Matsuoka teaches that ultra-pure water is jetted onto a workpiece surface to form a liquid boundary layer, not to penetrate or pass through an already-present liquid boundary layer. The claimed methods, conversely, recite that a heated liquid boundary layer is first formed on the workpiece, and a liquid jet (or jet of steam) is then directed through the boundary layer to physically dislodge contaminants from the workpiece.

Moreover, referring to Figs. 1-3 of Matsuoka, if the water were jetted at a high enough pressure to dislodge contaminants, the water would likely deflect off of the substrate surface, because the spray angle is nearly parallel to the workpiece surfaces. Thus, in Matsuoka, the term "jetted," which is not defined or explained, clearly refers to something that is very different from the claimed liquid jet (or jet of steam), and Matsuoka does not contemplate or suggest directing a liquid jet through a heated liquid boundary layer to physically dislodge contaminants from a workpiece, as claimed.

Indeed, Matsuoka teaches only a method of chemically treating a workpiece with an ozone-containing solution (the ozone dissolves into the liquid layer and reacts at the workpiece surface) to remove an organic coating from the workpiece. Matsuoka does not teach the additional step of physically dislodging contaminants from the workpiece with a liquid jet, as claimed. None of the other cited references teach or suggest the claimed step of directing a liquid jet through a boundary layer to physically dislodge/remove contaminants from a workpiece.

This point applies to an even greater extent with respect to claims 3 and 4. Regarding claim 22, a jet diameter of .5-10 mm is clearly patentably distinct from a "spray" because a "spray" as in Matsuoka has no diameter. In Matsuoka, the spray just expands outwardly from the manifold. See Figs. 1-3 of Matsuoka. Thus, the claimed methods include an additional step for removing contaminants that is not taught or suggested by the prior art.

Claim 25 has been amended to expressly describe a heating step. Matsuoka expressly teaches away from heating. See Matsuoka, p. 3, lines 34-35; p. 4, lines 33-34; Example 1 on page 5; and Comparative Example 1 on page 6. Moreover, there is no heater disclosed in Matsuoka. In addition, neither Matsuoka or the other prior art disclose the temperature ranges of claims 5, 40 or 41.

With respect to claims 3 and 4, none of the cited references teach or suggest pressurizing a liquid jet to a pressure of 100-15,000 psi, or 400-800 psi, as claimed. Such high pressures facilitate the physical removal of contaminants with a liquid jet.

In view of the foregoing, it is submitted that the claims are in condition for allowance, and a Notice of Allowance is requested.

Respectfully submitted,
Perkins Coie LLP

Date: Sept. 2, 2003

Kenneth H. Ohriner
Registration No. 31,646

Correspondence Address:

Customer No. 34055
Perkins Coie LLP
Patent – LA
P.O. Box 1208
Seattle, WA 98111-1208
Phone: (310) 788-9900
Fax: (310) 788-3399

COMPLETE SET OF PENDING CLAIMS

1. (Previously Presented) A method for cleaning a flat media workpiece comprising the steps of:

forming a boundary layer of a heated liquid on the workpiece;

providing ozone into the environment around the workpiece; and

directing a liquid jet through the boundary layer to physically dislodge a contaminant on the workpiece.

2. (Previously Presented) The method of claim 1 where the liquid jet comprises water.

3. (Previously Presented) The method of claim 1 where the liquid jet is pressurized to about 100-15,000psi.

4. (Previously Presented) The method of claim 1 where the liquid jet is pressurized to about 400-800psi.

5. (Previously Presented) The method of claim 1 further comprising the step of heating the liquid jet to 65-99 degrees C.

6. (Original) The method of claim 1 where the ozone is provided as a dry gas into the environment around the workpiece.

7. (Previously Presented) The method of claim 1 where the ozone is provided into the environment around the workpiece by introducing ozone into the liquid used to form the liquid jet.

8. (Original) The method of claim 1 further comprising the step of spinning the workpiece to help form the boundary layer

9. (Original) The method of claim 2 where the liquid further comprises a member selected from the group consisting of hydrofluoric acid, hydrochloric acid, ammonium hydroxide, and hydrogen peroxide.

10. (Original) The method of claim 1 where the liquid comprises a member selected from the group consisting of sulfuric acid, phosphoric acid, and halogenated hydrocarbons.

11. (Original) The method of claim 1 further comprising the step of irradiating the workpiece with electromagnetic energy.

B1

12. (Original) The method of claim 11 wherein the electromagnetic energy comprises a member selected from the group consisting of ultraviolet, infrared, microwave, gamma or x-ray radiation.

13. (Previously Presented) The method of claim 1 further comprising the step of moving the liquid jet relative to the workpiece, so that substantially all areas of the workpiece surface facing the jet are exposed at least momentarily to the jet.

14. (Previously Presented) The method of claim 1 where the liquid jet is perpendicular to the workpiece.

15. (Original) The method of claim 13 further comprising the step of placing the workpiece within a process chamber.

16. (Original) The method of claim 8 where the workpiece is rotated at about 100-2000rpm.

17. (Previously Presented) The method of claim 13 further including the step of moving the liquid jet on a swing arm within the chamber.

18. (Original) The method of claim 1 further comprising the step of introducing sonic energy to the workpiece.

19. (Original) The method of claim 18 where the sonic energy is introduced to the workpiece by a sonic transducer in the chamber and in contact with the workpiece.

B1

20. (Previously Presented) The method of claim 18 where the sonic energy is introduced to the workpiece by introducing sonic energy into a nozzle forming the liquid jet.

21. (Previously Presented) The method of claim 1 further comprising the step of cooling the heated liquid to a temperature below ambient, to increase the density of the heated liquid and the energy imparted to the workpiece as the liquid jet contacts the workpiece.

22. (Previously Presented) The method of claim 1 where the liquid jet has a diameter of from about .5-10 mm.

23. (Previously Presented) The method of claim 1 where the workpiece has a top surface and a bottom surface, and where the liquid jet is directed from below against the bottom surface.

24. (Original) The method of claim 13 where the relative movement occurs at a rate of from about .5 – 500 linear mm per second.

25. (Presently Amended) A method for cleaning a flat workpiece comprising the steps of:

heating a liquid;

providing heated liquid onto a surface of the workpiece;

spinning the workpiece to form the heated liquid into a boundary layer;

B1

moving a high pressure liquid jet across the surface of the workpiece, with the jet penetrating through the boundary layer and impacting against the surface of the workpiece, to physically remove a contaminant from the surface; and

providing ozone around the workpiece, with the ozone diffusing through the boundary layer.

26. (Original) The method of claim 25 where the ozone is provided by placing the workpiece into a chamber and supplying ozone gas into the chamber.

27. (Previously Presented) The method of claim 25 where the ozone is provided by supplying ozone into the liquid forming the liquid jet.

28. (Original) The method of claim 25 further comprising heating the workpiece.

29. (Previously Presented) The method of claim 28 where the heating is performed by heating the liquid jet.

30. (Original) The method of claim 28 where the heating is performed by introducing steam to the workpiece.

31-34. (Cancelled)

35. (Original) A method for cleaning a flat media workpiece comprising the steps of:

forming a boundary layer of a heated liquid on the workpiece;

providing ozone into the environment around the workpiece, with the ozone diffusing through the boundary layer; and

directing a jet of steam through the boundary layer to physically dislodge a contaminant on the workpiece.

36. (Original) The method of claim 35 where the boundary layer of heated liquid is formed via condensation of the steam from the jet of steam.

37. (Previously Presented) The method of claim 1 where the boundary layer of heated liquid is formed from the liquid jet.

38. (Cancelled)

39. (Previously Presented) The method of claim 1 wherein the liquid jet is at an oblique angle to the workpiece.

40. (Previously Presented) The method of claim 1 wherein the heated liquid is at a temperature in the range of 55-120° C.

B1

41. (Previously Presented) The method of claim 40 wherein the heated liquid is at a temperature in the range of 85-105° C.